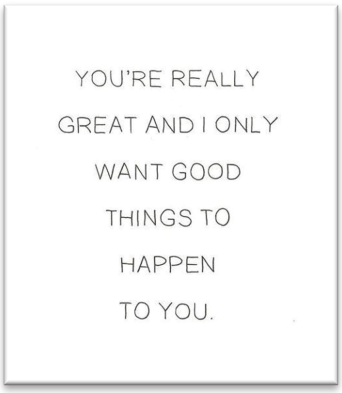
Name: _____ Period: _____ Date: _____

# Honors Chemistry Final Exam Study Guide

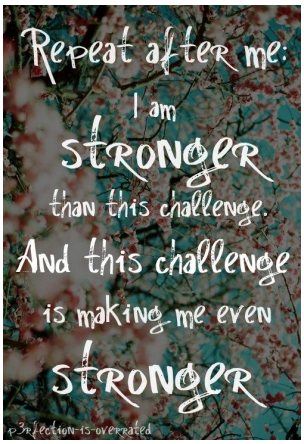
| Unit | Subtopics |
|---|---|
| ***Introduction to Matter*** | • Atoms vs. elements vs. compounds<br>• Mixtures vs. pure substances<br>• Heterogeneous and homogenous mixtures<br>• Chemical and physical properties<br>• Chemical and physical changes |
| ***Atomic Structure*** | • Basic contributions of Democritus, Dalton, Thomson, Rutherford, and Bohr<br>• Difference between atoms, elements, and compounds<br>• Location of protons, neutrons, and electrons<br>• Calculate protons, neutrons, electrons in neutral atoms and ions<br>• Cations vs. anions<br>• Isotopes<br>• Average atomic mass<br>• Electron configuration and orbital diagrams (including Hund's/Pauli exclusion/Aufbau) |
| ***Periodic Table*** | • Groups vs. periods<br>• Properties of metals and nonmetals<br>• Properties of alkali metals, alkaline earth metals, transition metals, halogens, and noble gases<br>• Charges of elements on the periodic table<br>• Valence electrons of elements on the periodic table<br>• Periodic trends (atomic radius, electronegativity, ionization energy) |
| ***Chemical Bonding*** | • Properties of ionic and covalent compounds<br>• Naming covalent, ionic, polyatomic, and transition metal compounds<br>• Lewis dot diagrams for compounds containing single, double, or triple bonds (including polyatomic ions)<br>• VSEPR theory |
| ***Chemical Reactions*** | • Law of Conservation of Matter<br>• Balancing equations<br>• Identifying types of chemical reactions<br>• Predicting the products of synthesis, decomposition, single replacement, and double replacement reactions<br>• Precipitation reactions (solubility rules) and using the activity series of metals<br>• REDOX reactions<br>• Collision theory/factors affecting reaction rate |
| ***Moles and Stoichiometry*** | • Mole conversions<br>• Percent composition<br>• Percent error<br>• Empirical formulas<br>• Molecular formulas<br>• Stoichiometry<br>• Limiting reagents, excess reagents, and percent yield |
| ***Acids and Bases*** | • Identifying Brønsted-Lowry acids, bases, conjugate acids, and conjugate bases<br>• pH/pOH calculations<br>• Strong acids and bases<br>• Neutralization reactions<br>• Titration calculations |

# Reference Materials

| Polyatomic Ions | |
|---|---|
| $NH_4^{+1}$ | Ammonium |
| $CO_3^{-2}$ | Carbonate |
| $ClO_3^{-1}$ | Chlorate |
| $SO_4^{-2}$ | Sulfate |
| $C_2H_3O_2^{-1}$ | Acetate |
| $OH^{-1}$ | Hydroxide |
| $CN^{-1}$ | Cyanide |
| $PO_4^{-3}$ | Phosphate |
| $NO_3^{-1}$ | Nitrate |
| $HCO_3^{-1}$ | Bicarbonate |
| $ClO_4^{-1}$ | Perchlorate |
| $MnO_4^{-1}$ | Permanganate |
| $CrO_4^{-2}$ | Chromate |
| $NO_2^{-1}$ | Nitrite |
| $Cr_2O_7^{-2}$ | Dichromate |
| $ClO_2^{-1}$ | Chlorite |









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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Hydrogen 1 H 1.008 | | | | | | | | | | | | | | | | | Helium 2 He 4.003 |
| Lithium 3 Li 6.941 | Beryllium 4 Be 9.012 | | | | | | | | | | | Boron 5 B 10.811 | Carbon 6 C 12.011 | Nitrogen 7 N 14.007 | Oxygen 8 O 15.999 | Fluorine 9 F 18.998 | Neon 10 Ne 20.180 |
| Sodium 11 Na 22.990 | Magnesium 12 Mg 24.305 | | | | | | | | | | | Aluminum 13 Al 26.982 | Silicon 14 Si 28.086 | Phosphorus 15 P 30.974 | Sulfur 16 S 32.066 | Chlorine 17 Cl 35.453 | Argon 18 Ar 39.948 |
| Potassium 19 K 39.098 | Calcium 20 Ca 40.078 | Scandium 21 Sc 44.956 | Titanium 22 Ti 47.88 | Vanadium 23 V 50.942 | Chromium 24 Cr 51.996 | Manganese 25 Mn 54.938 | Iron 26 Fe 55.847 | Cobalt 27 Co 58.933 | Nickel 28 Ni 58.693 | Copper 29 Cu 63.546 | Zinc 30 Zn 65.39 | Gallium 31 Ga 69.723 | Germanium 32 Ge 72.61 | Arsenic 33 As 74.922 | Selenium 34 Se 78.96 | Bromine 35 Br 79.904 | Krypton 36 Kr 83.80 |
| Rubidium 37 Rb 85.468 | Strontium 38 Sr 87.62 | Yttrium 39 Y 88.906 | Zirconium 40 Zr 91.224 | Niobium 41 Nb 92.906 | Molybdenum 42 Mo 95.94 | Technetium 43 Tc 97.907 | Ruthenium 44 Ru 101.07 | Rhodium 45 Rh 102.906 | Palladium 46 Pd 106.42 | Silver 47 Ag 107.868 | Cadmium 48 Cd 112.411 | Indium 49 In 114.82 | Tin 50 Sn 118.710 | Antimony 51 Sb 121.757 | Tellurium 52 Te 127.60 | Iodine 53 I 126.904 | Xenon 54 Xe 131.290 |
| Cesium 55 Cs 132.905 | Barium 56 Ba 137.327 | Lanthanum 57 La 138.906 | Hafnium 72 Hf 178.49 | Tantalum 73 Ta 180.948 | Tungsten 74 W 183.84 | Rhenium 75 Re 186.207 | Osmium 76 Os 190.2 | Iridium 77 Ir 192.22 | Platinum 78 Pt 195.08 | Gold 79 Au 196.967 | Mercury 80 Hg 200.59 | Thallium 81 Tl 204.383 | Lead 82 Pb 207.2 | Bismuth 83 Bi 208.980 | Polonium 84 Po 208.982 | Astatine 85 At 209.978 | Radon 86 Rn 222.018 |
| Francium 87 Fr 223.020 | Radium 88 Ra 226.025 | Actinium 89 Ac 227.028 | Rutherfordium 104 Rf (261) | Dubnium 105 Db (262) | Seaborgium 106 Sg (263) | Bohrium 107 Bh (262) | Hassium 108 Hs (265) | Meitnerium 109 Mt (266) | | | | | | | | | |

# SOLUBILITY TABLE

| | Ions | Solubility |
|---|---|---|
| GENERALLY SOLUBLE | Alkali metals, $NH_4^+$, $NO_3^-$, $ClO_3^-$, $ClO_4^-$, $C_2H_3O_2^-$, $HCO_3^-$ | Always soluble |
| | Halogens | Soluble EXCEPT with Ag, Pb, Hg, $Cu^{+1}$ |
| | $SO_4^{-2}$ | Soluble EXCEPT with Ca, Sr, Ba, Pb |
| GENERALLY INSOLUBLE | $O^{-2}$, $OH^-$ | Insoluble EXCEPT with Ba, Ca, Sr, and alkali metals |
| | $CO_3^{-2}$, $PO_4^{-3}$, $S^{-2}$, $SO_3^{-2}$, $C_2O_4^{-2}$, $CrO_4^-$ 2 | Insoluble EXCEPT with alkali metals and $NH_4^+$ |

*HALOGENS = F, Cl, Br, I, At,
*ALKALI METALS = Li, Na, K, Rb, Cs, Fr

**ACTIVITY SERIES:**

| Metal | Oxidation Reaction |
|---|---|
| Lithium | $Li \rightleftharpoons Li^+ + e^-$ |
| Rubidium | $Rb \rightleftharpoons Rb^+ + e^-$ |
| Potassium | $K \rightleftharpoons K^+ + e^-$ |
| Barium | $Ba \rightleftharpoons Ba^{2+} + 2e^-$ |
| Calcium | $Ca \rightleftharpoons Ca^{2+} + 2e^-$ |
| Sodium | $Na \rightleftharpoons Na^+ + e^-$ |
| Magnesium | $Mg \rightleftharpoons Mg^{2+} + 2e^-$ |
| Aluminum | $Al \rightleftharpoons Al^{3+} + 3e^-$ |
| Manganese | $Mn \rightleftharpoons Mn^{2+} + 2e^-$ |
| Zinc | $Zn \rightleftharpoons Zn^{2+} + 2e^-$ |
| Chromium | $Cr \rightleftharpoons Cr^{3+} + 3e^-$ |
| Iron | $Fe \rightleftharpoons Fe^{2+} + 2e^-$ |
| Cobalt | $Co \rightleftharpoons Co^{2+} + 2e^-$ |
| Nickel | $Ni \rightleftharpoons Ni^{2+} + 2e^-$ |
| Tin | $Sn \rightleftharpoons Sn^{2+} + 2e^-$ |
| Lead | $Pb \rightleftharpoons Pb^{2+} + 2e^-$ |
| Hydrogen | $H_2 \rightleftharpoons 2\,H^+ + 2e^-$ |
| Copper | $Cu \rightleftharpoons Cu^{2+} + 2e^-$ |
| Silver | $Ag \rightleftharpoons Ag^+ + e^-$ |
| Mercury | $Hg \rightleftharpoons Hg^{2+} + 2e^-$ |
| Platinum | $Pt \rightleftharpoons Pt^{2+} + 2e^-$ |
| Gold | $Au \rightleftharpoons Au^{3+} + 3e^-$ |

Metals at the top of the table are most easily oxidized.

**RULES FOR ASSIGNING OXIDATION NUMBERS:**

1. *The oxidation number of a monatomic ion is equal to its ionic charge. For example, the oxidation number of bromide is -1 and the oxidation number of calcium is +2.*
2. *The oxidation number of hydrogen in a compound is +1.*
3. *The oxidation number of oxygen in a compound is -2, except for in compounds with the more electronegative fluorine, where it is positive.*
4. *The oxidation number of an atom in uncombined (elemental) form is zero. For example, the oxidation number of potassium atoms in potassium metal (K) or of the nitrogen atoms in nitrogen gas ($N_2$) is zero.*
5. *For any neutral compound, the sum of the oxidation numbers of the atoms in the compound must equal zero.*